

The Optimum Population of China in the 21st Century

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In-Progress Work

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August 30th,2011



Outline

- Background
- Literature Review
- Research Questions
- > Methods
- Preliminary Results



Backgroud

1. China's Population Dynamics in history

2. China's Socioeconomic Development



1.China's Population Dynamics in History (Before 206 B.C.)



China's Population Growth before 206 B.C.



1.China's Population Dynamics in History (2 A.D.---1990 A.D.)



Source: Vaclav Smil, China's Environmental Crisis (1993)



1.China's Population Dynamics in History (1949---2010)

total population(Millions)



1949 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010



1.China's Population Dynamics in History Ancient Population Shares in the World

 For most of its history, China's population shares in the world were greater than 20% and often around 30%, with exception of slightly lower than 10% at the end of the Eastern Han Dynasty.

(Ge Jianxiong,2008)



1.China's Population Dynamics in History Population Shares in the World(1950--2010)





1.China's Population Dynamics in History China's Population Transition



Source: China Statistic Yearbook1991 and 2010



2. China's SocioeconomicDevelopment

China's Human Development Index(HDI)



HDI



2.China's Socioeconomic Development Ranking of China's GDP in the world

Year	1978	1980	1990	2000	2007	2008	2009	2010
Rank	10	11	11	6	4	3	3	2

International Statistical Yearbook(2010); World Bank(2011)



2.China's Socioeconomic Development Ranking of China's Gross National Income(GNI) per capita in the world

Year	1978	1980	1990	2000	2007	2008	2009	2010
Rank	175	177	178	141	132	127	124	121

International Statistical Yearbook(2010); World Bank(2011)



2.China'sSocioeconomicDevelopment Agriculture





2.China'sSocioeconomicDevelopment

Trends in average supply of food energy in China, India and Japan



Source: Plotted from data in Piazza (1983) and from various volumes of FAO's Food Balance Sheets.



Between 1980 and 2000 China's dietary transition followed a universal pattern of declining tuber and pulse consumption, and increasing intakes of animal foods, fruits, plant oils and alcoholic beverages *Source: Vaclav Smil, China's Past, China's Future, 2003.*



Literature Review:

- 1.Concept
- 2. China's Optimum Population
- 3. Population-Balanced Society



Literature Review: 1.Concept

- At any given time, the population which can exist on a given extent of land, consistent with the attainment of the greatest productiveness of industry possible at the time, is definite. (Edwin Cannan, 1888; Knut Wecksell, 1911)
- Criteria: Maximizing productiveness(Economic Optimum Population)



Literature Review: 1.Concept

Economic Optimum Population

Assumptions:

- 1) Static(given time)
- 2) Given technology level
- 3) Given extent of land
- 4) Full employment
- Concentrate on population size(not distinguish between working age population and total population, forget about age distribution)



Literature Review: 1.Concept

Average Productivity = $\frac{\text{Total Output}}{\text{Total Labor Input}}$

Slide 19

Chapter 6



Literature Review: 1.Concept

The Law of Diminishing Marginal Returns

$$MP_{L} = \frac{\Delta Output}{\Delta Labor Input} = \frac{\Delta Q}{\Delta L}$$

- When the labor input is small, *MP* increases due to specialization.
- When the labor input is large, *MP* decreases due to inefficiencies.



Literature Review:

1.Concept:Economic Optimum Population



Chapter 6



 An optimum population is the one that achieves a given aim in the most satisfactory way.

(Alfred Sauvy, 1969:P36)

Criteria:

- Maximum power (the various means that can be harnessed to a collective aim, Power Optimum Population);
- Maximum living standards (average output per individual, Economic Optimum Population)



• Various possible aims:

- 1.Individual welfare;
- □ 2.Increase of wealth;
- □ 3.Employment;
- 4.Power;
- □ 5.Long life, health;
- 6.Culture,knowledge;
- □ 7.The sum of welfare;
- □ 8.The sum of life;
- 9. The number of inhabitants
- (Alfred Sauvy, 1969:P38)





- Pp: Power optimum population
- P: economic optimum population





- Pp: Power optimum population
- Pm: Maximum population



- Besides, even if it were possible, at a given point in time, to calculate a country's optimum population correctly, it would still be difficult to base a population policy on that calculation.
- Thus, there is also a question of time involved.

(Alfred Sauvy, 1969:P36)



Literature Review: 1.Concept:Optimal Growth Rate

Criterion 1: Minimizing the overall demographic dependency rate Criterion 2: Minimizing economic dependency rate Criterion 3: Maximizing net per-capita consumption (J.Schmitt-Rink, 1989)

overall demographic dependency rate = $\frac{\text{Children} + \text{Retirees}}{\text{Active Population}}$

economic dependency rate = $\frac{\text{Income for dependency of Children and Retirees}}{\text{Total income}}$

net per-capita consumtion = per-capita income - dependency burden per active person



Literature Review: 1.Concept:Optimal Growth Rate

n* for Criterion 1;

- n**for Criterion 2;
- n*** for Criterion 3;
- n* is slightly negative(typical life tables and productive age-spans of industrialization countries).

It is not clear whether n** and n*** are positive, zero or negative.

n** and n*** coincide with n* in very special cases only. (J.Schmitt-Rink, 1989)



Literature Review: 2.China's Optimum Population

The necessity of the balance between population and land:

- If there are more people than land can support, the state will become weak because its gross of commissariat can't support its huge army.
- On the other hand, if there are more land than people can cultivate, various resources of the state can't be fully utilized.

(Shang Yang , about 390 - 338 B. C.)



Literature Review: 2.China's Optimum Population

- Even so, the increase in land and houses will be just double, three times, or at most five times the original, whereas the population has increased 10 or 20 times.
- In other words, the amount of land and the number of houses will always be deficient compared with the size of population.
- (Hong Liangji, 1746-1806)



Literature Review: 2.China's Optimum Population

- Based on China's agricultural resources and employment, "a population within 800 million can definitely be provided with a life".
- So,I believed that 800 million is the optimum size of our population.
 (Sun Benwen, 1957)



Literature Review: 2.China's Optimum Population

• Criteria:

- The growth rate of total productive fixed assets and the improvement rate of technical equipments per worker(*Tian Xueyuan et al*, 1981)
- Integrated Possibility-Satisfaction Degree (more than 20 indicators) (Hu Baosheng et al, 1981)
- Food resources, fresh water resources and economic development (Song Jian et al, 1985)
- Land carrying capacity (CISNR, 1986)
- Economic optimum, natural resource's carrying capacity, environmental capability, preventing serious population aging(*Hu Angang*, 1989)
- Coordination among the demographic characteristics, employment, and industrial structure (Mao Zhifeng, 1995)



Literature Review: 2.China's Optimum Population Case 1: Song Jian etc.,1985





Literature Review: 2.China's Optimum Population Case 2: Hu Baosheng etc.,1981

- More than 20 indicators covering natural resources, environment, economy, population state and national psychology
- Possibility-Satisfaction Degree(PSD): Possibility
 × Satisfaction
- Criteria: Overall PSD(OPSD)



Case 2: Hu Baosheng etc.,1981

	Indicators											
Hypo- thesis	Food		Use		Power		Population process		International	2080 Pop (B)	OPSD	
	Grain	Fish	Land	Water	Air	Energy	GNP	TFR	Aging	comparison	(2)	
1	All considered								1.05	0.25		
2	Partly mutual compensated							Consid	ered	1.4	0.68	
3	Considered Not Considered							≤0.54	≥0.9			
4	Partly mutual compensated Not Considered							≤0.7	≥0.9			
5	Considered						Con.	Not Con.	Con.	0.7	0.65	
6	Partly mutual compensated						Con.	Not Con.	Con.	0.7~1.0	0.83	



Case 2: Optimum Population(Hu Baosheng etc., 1981)





Literature Review: 3. Population-Balanced Society

• Concept :

a society with dynamic balances among population size, quality, structure and distribution while its population dynamics is in harmony with socioeconomic development as well as the capacity of resources and environment

(Xiao Zihua, 2010)



Literature Review:

3. Population-Balanced Society

Population-Balanced Indicator System:

- three levels of indicators
- Weight setting: Expert Opinions(questionnaire)
- Z-score Method

(Wang Ying <u>et al</u> 2011)







Research Questions

- 1.What kind of population should be China's veritable optimum population within 21st Century?
- 2.How can China achieve and maintain its optimum population ?
- 3.What this population process would mean for China's socioeconomic development?



Methods

- Scenario analysis
- Multiple-Objective Decision analysis
- Cohort-Component Projection
- Qualitative analysis



Preliminary Results:

- 1.Definition
- 2.Assumptions
- 3.Scenarios
- 4.Conclusion



Preliminary Results: 1.Definition

China's veritable optimum population within 21st Century:

- Stationary population
- Smooth path to achieve
- Maximizing Overall Satisfaction



Preliminary Results: 2.Assumptions:

• Life Expectancy at Birth:

First stage(before stable model):UN Medium Variant Projection

Second stage(stable model): Average value of UN Medium Variant Projection



Assumptions: Life Expectancy at Birth

- Assumption a: for male, from 72.07 to 73.80, 2010-2024, and 78.78, thereafter; for female, from 75.61 to 77.58, 2010-2024, and 82.72, thereafter
- Assumption b: for male, from 72.07 to 74.58, 2010-2029, and 79.08, thereafter; for female, from 75.61 to 78.43, 2010-2029, and 83.03, thereafter
- Assumption c: for male, from 72.07 to 75.31, 2010-2034, and 79.37, thereafter; for female, from 75.61 to 79.21, 2010-2034, and 83.32, thereafter



Assumptions: Life Expectancy at Birth

- Assumption d: for male, from 72.07 to 75.97, 2010-2039, and 79.65, thereafter; for female, from 75.61 to 79.91, 2010-2039, and 83.61, thereafter
- Assumption e: for male, from 72.07 to 76.63, 2010-2039, and 79.93, thereafter; for female, from 75.61 to 80.57, 2010-2039, and 83.88, thereafter
- Assumption f: for male, from 72.07 to 77.25, 2010-2049, and 80.20, thereafter; for female, from 75.61 to 81.20, 2010-2049, and 84.15, thereafter



Preliminary Results: 2.Assumptions:

• Total Fertility Rate :

Current Level : Average of sample surveys (2005-2010)

First stage(before stable model): Linear change from current level to replacement level

Second stage(stable model):Replace level



BHM Projections of Total Fertility



Source: UN(2011): World Population Prospects: The 2010 Revision. New York



Assumptions: Total Fertility Rate

- Assumption A:Linear change from 1.395 to 1.90,2010-2024;2.07,thereafter
- Assumption B: Linear change from 1.395 to 2.1,2010-2029;2.1,thereafter
- Assumption C: Linear change from 1.395 to 2.1,2010-2034;2.1,thereafter



Assumptions: Total Fertility Rate

- Assumption D: Linear change from 1.395 to 2.1,2010-2039;2.1,thereafter
- Assumption E: Linear change from 1.395 to 2.1,2010-2044;2.1,thereafter
- Assumption F: Linear change from 1.395 to 2.1,2010-2049;2.1,thereafter



Preliminary Results: 3.Scenarios

- Scenario1:Assumption a + A
- Scenario2:Assumption b + B
- Scenario3:Assumption c + C
- Scenario4:Assumption d + D
- Scenario5:Assumption e + E
- Scenario6:Assumption f + F



Preliminary Results: 3.Scenarios

Indicators	Weights	Satisfaction settings
Food output per capita(kg/p/y)	0.2222	S(<400)=0,S(>800)=1,S(400- 800)linear change
Energy capacity per capita(kg ce)	0.2222	S(<2000)=0,S(>6000)=1, S(2000- 6000)linear change
Average schooling years	0.1667	S(<8)=0,S(>15)=1, S(8-15)linear change
Doctors per 10000 people	0.2222	S(<14)=0,S(>30)=1, S(14-30)linear change
Dependency Ratio	0.1667	S(<45)=1,S(>80)=0, S(45-80)linear change



Scenario 1:Stable from 2025





Scenario 2:Stable from 2030





Scenario 3:Stable from 2035





Scenario 4:Stable from 2040





Scenario 5:Stable from 2045





Scenario 6:Stable from 2050





Scenario 7:Keeping current fertility





Scenario Comparison





Preliminary Results: 4.Conclusion

- China's optimum population can be achieved if TFR increases smoothly to replacement level around 2050, with 1.2 billion in 2100.
- 2) Due to population aging, high dependency ratio will be very significant from 2050 to 2070
- 3) If China's TFR keep current level, dependency ratio will be higher than 80 in 2100